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ABSTRACT

This document outlines a computerized management tool designed to enable building managers to identify energy consumption as related to types and uses of school facilities for the purpose of evaluating and managing the operation, maintenance, modification, and planning of new facilities. Specifically, it is expected that the statistics generated will (1) provide information to aid in evaluating the human element of operating the facility, with reasonable consideration for the cost of energy consumed; (2) identify malfunctions of equipment and/or controls that result in unusual consumption of energy; (3) identify inefficient equipment that should be modified or replaced; (4) provide a comparative evaluation of different types of building enclosures in terms of energy consumed; (5) provide a comparative evaluation of different types of mechanical systems in terms of energy consumed; and (6) provide statistical information for forecasting energy consumption and managing budgeted funds. (Author/DN)

ED 078508

Felix E. Oswalt
Dec. '72

BOARD OF EDUCATION
MEMPHIS CITY SCHOOLS
DEPARTMENT OF PLANT MANAGEMENT

COMPUTER PROFILE OF SCHOOL FACILITIES ENERGEY CONSUMPTION

In light of current statistics and publicity on the "Energy Crisis", the related problems of pollution, and inflationary energy cost projections, there appears to be a definite need for a more effective management tool to better identify the effect of the interacting of the many variables involving school facilities and energy requirements. Computer statistics should identify energy consumption as related to types and uses of School Facilities for the purpose of evaluating and managing the operations, maintenance, modifications, and planning of new facilities. At present we are operating on general guidelines as to when to turn off lights, and under what conditions we modify comfort levels (night set back) or turn off energy consuming equipment. Bills are paid as submitted with little information being available to evaluate performance both human and mechanical, or efficiency of energy utilization.

Our current budget for electricity and gas is $1,777,905.00 and represents 1.825% of the operating budget of the Board of Education for the 1972-73 school year. Possibly we can effect as much as a 2% or $35,000.00, annual reduction of energy cost, and at the same time obtain valuable information that will enable us to build into schools both new and old those features and modifications that will give true economy to the overall management of facilities, as well as conserve energy.

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OBJECTIVES

1. Provide information that will aid in evaluating the human element of operating the facility with reasonable consideration for the cost of energy consumed.
2. Identify malfunctions of equipment and/or controls that result in unusual consumption of energy.
3. Identify inefficient equipment that should be replaced or modified.
4. Provide a comparative evaluation of different types of building enclosures in terms of energy consumed. Would be useful in planning of new and modifying of existing facilities.
5. Provide a comparative evaluation of different types of mechanical systems in terms of energy consumed. Would be useful in planning new or modifying of existing mechanical systems to improve comfort level or control energy cost.
6. Provide statistical information for forecasting energy consumption and managing budgeted funds.

BASIC INFORMATION

Area of building measured in square feet or possibly 1,000's of square feet.

Volume of buildings measured in cubic feet or possibly 1,000's of cubic feet.

Enclosure - general classification of building as related to heat gain and heat loss.

Number of Stories Code 1, 2, 3, 4

Glass Area Exterior Classroom wall

Code 1 40% or more (older designs where maximum windows were employed for light and ventilation)

Code 2 10% or less (newer designs with reduced window areas usually A/C.

Configuration of Floor Plan

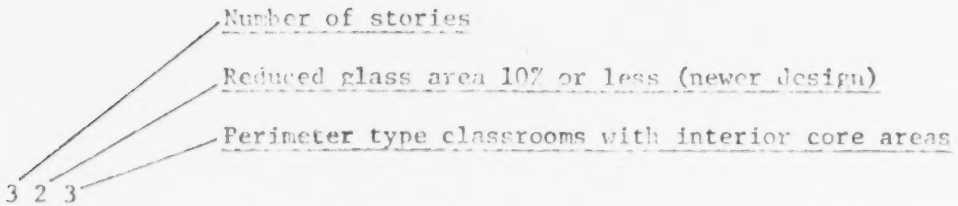
Code 1 Single loaded corridors without interior core areas.

Code 2 Double loaded corridors without interior core areas.

Code 3 Perimeter type classrooms with interior core areas.

Code 4 Open plan with interior core areas.

Example:



Mechanical Systems - general classification based on identifying characteristics

Piping and/or Distribution System

Code 1 Heating only from central plant.

Code 2 Heating only from package units direct fired.

Code 3 Heating and A/C from package units.

Code 4 Two pipe hydronic system with heating and A/C.

Code 5 Four pipe hydronic for heating and A/C.

Code 6 Four pipe hydronic for heating and A/C with terminal reheat.

*Dilution Factor Piping and/or Distribution System

Terminal Equipment

Code 1 Direct transfer material conversion and/or radiation.

Code 2 Direct transfer with 10-30% ventilation.

Code 3 Air handling with 100% outside air capabilities.

Code 4 Air handling with 10-30% fresh air.

*Dilution Factor for Terminal Equipment

Heat Source or Mechanical Equipment

Code 1 Hot water boiler central system.

Code 2 Steam boiler central system.

Code 3 Package units direct fired.

*Dilution Factor for Heat Source or Mechanical Equipment

Cooling Source or Mechanical Equipment

Code 0 No cooling provided .

Code 1 Water chiller with centrifugal compressor.

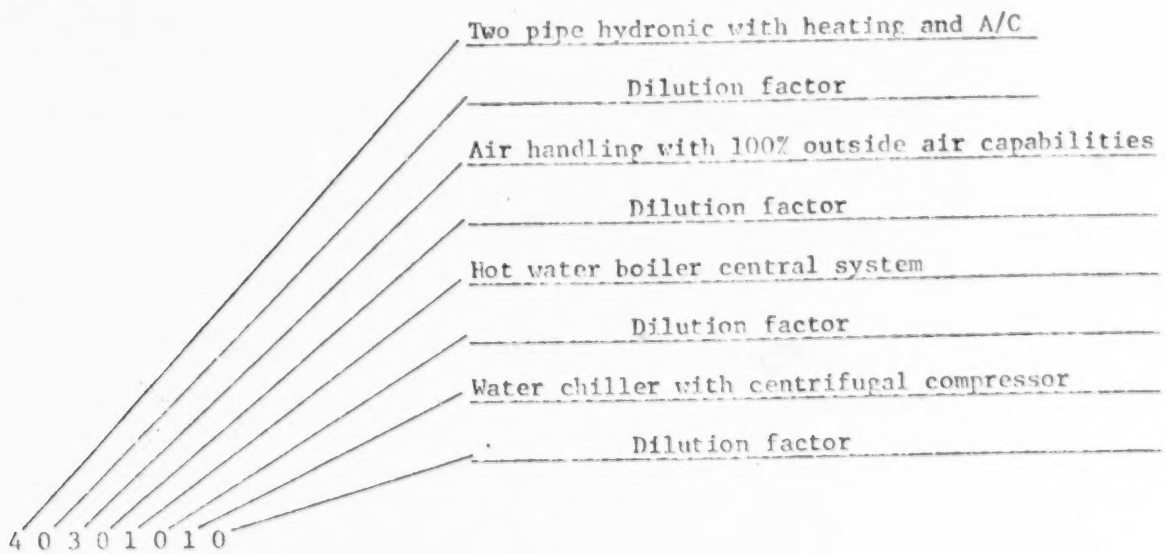
Code 2 Water chiller with reciprocating compressor with water cooled condenser.

Code 3 Water chiller with reciprocating compressor with air cooled condenser.

Code 4 Direct expansion.

*Dilution Factor of Cooling Source or Mechanical Equipment

EXAMPLE:


Two pipe hydronic with heating and A/C
Dilution factor
Air handling with 100% outside air capabilities
Dilution factor
Hot water boiler central system
Dilution factor
Water chiller with centrifugal compressor
Dilution factor
4 0 3 0 1 0 1 0

*Dilution factor indicates what general percentage does not conform to the predominate system or equipment as detailed.

Code 0 All areas same characteristics.

Code 1 1-10% other than that detailed.

Code 2 11-20% other than that detailed.

Code 3 21-30% other than that detailed.

Code 4 31-40% other than that detailed.

Code 5 41-50% other than that detailed.

Program - Identify grade level and type of program. Identify any unusual characteristic such as heavy vocational where unusual energy requirements are to be noted.

Code 1 Any combination of grades 1 - 6.

Code 2 Jr. High - any combination of grades 7 - 9.

Code 3 Sr. High - any combination of grades 10 - 12.

Code 4 Sr. High - (10-12) with heavy vocational program.

Code 5 Combination embracing grade levels from both 1-6 and 7-9.

Code 6 Combination embracing grade levels from both 7-9 and 10-12.

Code 7 Combination embracing grade levels from 1-6, 7-9, and 10-12.

Code 8 Any facility that doesn't fit into above classifications.

VARIABLE INPUT:

Current Enrollment

Number of hours in regular operating schedule for interval. Need some gathering technique for determining the hours of regular operating time for period covered by meter reading. Would have different schedules for schools having night or other special programs that fall outside of regular operating day.

Electric Consumption for interval in kw.

Electric Cost for interval with demand charge identified.

Gas Consumption for interval in cubic feet or 100 cubic feet, depending on billing unit.

Gas Cost for interval.

Total Energy Cost

Degree Days Heating) Need gathering procedure to cover meter period
)
Degree Days Cooling) as readings are not all taken on same day.

VARIABLE OUTPUT:

Electric consumption kw/sq. ft. of building area.

Electric consumption kw/cu.ft. of building volume.

Electric consumption kw/pupil enrolled.

Electric consumption kw/hr. of reg. operation.

Electric cost/sq. ft. of building area.

Electric cost/cu.ft. of building volume.

Electric cost/pupil enrolled.

Electric cost/hr. of regular operation.

Gas consumption cu.ft./sq.ft. of building area.

Gas consumption cu.ft./cu.ft. of building volume.

Gas consumption cu.ft./pupil enrolled.

Gas consumption cu.ft./hr. of regular operation.

Gas cost/sq.ft. of building area.

Gas cost/cu.ft. of building volume.

Gas cost/pupil enrolled.

Gas cost/hr. of regular operation.

Total energy cost/sq.ft. of building area.

Total energy cost/cu.ft. of building volume.

Total energy cost/pupil enrolled.

Total energy cost/hr. of regular operation.

Administration by exception through comparative statistics should be of significant value in identifying good and bad characteristics of facilities and/or procedures.